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Measurement of droplet sizes in bubbly oil-in-water flows using a fluid-sampling device[1]

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Abstract: One important characteristic of bubbly oil-in-water two-phase flows is the droplet size distribution, which has a significant effect on the heat/mass transfer between phases and the turbulence characteristics. In this study, a sampling device of dynamic fluid is designed to trap the morphological structures of the bubbly oil-in-water flows with low flow rate and high water cut. In the experiment, oil droplets in vertical upward pipe are forced into a sampling slot which is specifically designed to ensure that the passing oil droplets are not overlapped. The images of the oil droplets are recorded using a high speed camera when the mixture flows through the sampling slot. The methods of multi-scale edge detection and watershed segmentation are employed to extract the edges of the solitary and adjoining oil droplets in the flow images. Based on the detected oil droplet edges the equivalent oil droplet diameters are derived and compared with a model of maximum droplet diameter. Additionally, time-frequency entropy and the total energy of measured conductance signals are extracted using Adaptive Optimal Kernel Time-Frequency Representation (AOK TFR) to characterize the droplet size distribution of bubbly oil-water two-phase flows.

Keywords: Oil-water two-phase flow; Sampling device; Droplet size; Multi-scale edge detection; Time-frequency characterization

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